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Natural Egg Sac Clutch Size of the Brown Widow Spider, *Latrodectus geometricus* (Araneae: Theridiidae) in Southern California

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The brown widow spider, *Latrodectus geometricus* C. L. Koch, 1841, is a non-native arachnid that became established in peninsular Florida in the 1930s (Pearson 1936). In the first decade of the 21st century, it rapidly spread through the southeastern United States and southern California (Brown et al. 2008; Vincent et al. 2008; Vetter et al. 2012a) and has become a ubiquitous urban pest species in the Los Angeles Basin and San Diego area (Vetter et al. 2012b). One possible reason for its success lies in its fecundity, as it can produce an egg sac every four days during its earliest ovipositions and averages 22 egg sacs in a lifetime (Bouillon and Lekie 1961).

We were interested in documenting the seasonal field egg production of brown widows from June to October to determine whether there is a specific peak and subsequent drop-off in productivity or whether it is fairly consistent throughout the summer season. This provided basic biology information that benefitted research involving insecticide bioassays on brown widow egg sacs (Vetter et al, in prep); knowing the phenology of seasonal clutch size helped determine whether lab-produced egg sacs would be temporally comparable with natural oviposition and, hence, whether pesticides tested on egg sacs would have real world relevance.

To determine monthly egg clutch size, brown widow egg sacs were collected during the day from several cities in Orange and Riverside counties, California from June through October 2012. Collections were restricted to urban sites such as around homes, in parks, under playground equipment, etc. as documented favored habitats for this spider (Vetter et al. 2012b). We attempted to collect egg sacs primarily from sites that were occupied by female brown widows as this presumedly increased the chances of collecting sacs with freshly laid eggs. The study was terminated at the end of October because temperatures cool considerably in November in southern California.

We did not collect egg sacs for the first seven days of any month in order to more accurately assign sacs with eggs to the correct month of oviposition. At 29°C, brown widow eggs hatch in 9 days. Considering that daily high temperatures in many of our collection locales are typically 35 to 40°C, we felt that this was an acceptable estimate to separate clutch size into monthly cohorts. We also received some sacs in the mail from citizen scientists who participated in previous brown widow studies (Vetter et al. 2012a,b); again, no data from sacs collected and received during the first week of the month were used.

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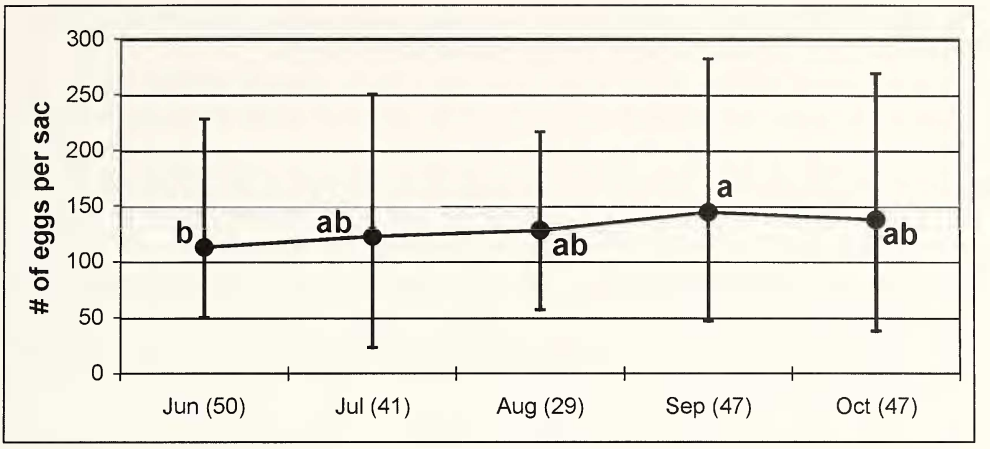

Fig. 1. Seasonal egg clutch size of field-collected brown widow spider egg sacs from June to October 2012 in southern California. Represented here is the minimum, maximum and mean for each month. The number in parentheses following the month is the sample size. Means sharing no letters in common are significantly different.

Egg sacs were dissected over petri dishes with fine forceps while viewed under a microscope. Eggs were counted soon after collecting or the sac was placed in the freezer to stop development, whereupon eggs were counted at a more convenient time. Freezing did not affect consistency of the contents; i.e., the eggs retained their round shape and did not collapse. We did not count any development stage past eggs as this would make it difficult to accurately assign the date of oviposition to a specific month. The sac was ripped open and its contents poured into a petri dish. We checked eggs to verify if they were viable (i.e., spherical and pearlescent rather than wrinkled or collapsed and discolored). Eggs were counted and the sac was checked for residual eggs stuck to the silk.

Numbers of eggs per sac by month were analyzed with ANOVA with separation of means determined by a Tukey's test. Of the many hundreds of egg sacs we dissected, 214 field-collected sacs contained an average of 129.0 ± 51.0 eggs. The monthly means were not statistically equal (ANOVA: $F = 2.87$, $df = 4$, $P = 0.024$). The only statistically significant monthly difference occurred between June with a low mean of 112.9 ± 43.4 and September with a high mean of 144.1 ± 57.5 (Fig. 1).

In this study, brown widow egg production was fairly steady for a 5-month period bracketing the summer with a significant monthly difference of brown widow egg sac clutch size between June and September (Fig. 1). Baerg (1954) reported that 11 brown widow spider egg sacs collected in Haiti when the rainy season was well underway produced an average of 88 eggs per sac (range = 19 to 138). In contrast, southern California brown widows produced about 50% more eggs in 2011 (mean = 143.7 ± 61.6, range = 57 to 286, N = 30) (Vetter et al. 2012a) and in 2012 (mean = 129.0 ± 51.0, range = 23 to 282, N = 214) (this study) although Baerg's average for a small sample size is not much different than our total for June alone (mean = 112.9). Similar to southern California, Triana et al. (2012) recorded 141.9 ± 62.4 eggs for 47 brown widow egg sacs in Costa Rica. Seasonal variation in clutch size is probably influenced by many factors including prey availability and female senescence. However, some of these factors may be ameliorated in urban southern California as the brown widow is a nuisance species and is

thriving around homes with artificially controlled landscaping probably providing a constant source of food for them throughout the warm months.

For the brown widows in our study, there was a fairly constant monthly rate of egg productivity unlike the bimodal periodicity of the uloborid spider *Octonoba octonarius* (Muma) (Peaslee and Peck 1983) or the well-known, late-summer spike of oviposition exhibited by orb weavers. Nor was there a seasonal cessation over the period we collected such as in the confamilial *Theridion melanurum* Hahn, which is an early season layer, ceasing egg production by the end of June in California's San Joaquin Valley (Vetter and Carroll 2013). The information provided by this study signified that we could conduct pesticide testing experiments from June through October and feel confident that we were procuring egg sacs from laboratory-maintained female brown widows during a period when they were normally producing sacs in nature.

Acknowledgments

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